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ABSTRACT

This history of computer text analysis of student writing while brief, is complicated by the fact that there are actually three distinct efforts underway to use the computer for such purposes. There is a certain amount of overlap among the efforts, but their intentions are different enough to warrant separate review. The first effort is toward automatic analysis of papers. In this approach, the computer is used to fully "correct" or otherwise comment on papers. The second effort creates a more cooperative relationship between the computer and writer. The computer performs a series of activities that make proofreading easier for the writer, but the writer is still in charge. The computer is a tool doing the bidding of the writer. In the third approach the computer is even less directive, and the process for revision and analysis is initiated by writers working collaboratively. The computer serves as a communication node as peers comment back and forth, reacting and revising over a period of time. Each of these approaches has evolved over time and is based on the work of people whose names and programs are generally unknown. All three approaches are still changing as the technology changes and as new ways are discovered to use effectively what the technology enables. (MM)

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# A History of Computer Analysis of Student Writing

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A recently released program announces itself as "Software relief for English teachers." It promises to automatically check student papers for spelling, usage, grammar, style, punctuation and capitalization "at night... while teacher sleeps!! (Smith)" This is quite an offer. Who could resist a chance to have a computer do all our work for us -- while we sleep. What a marvel of high technology.

Ignoring for the moment whether or not the program can actually do what it claims, and also ignoring whether or not we would actually want a program to do such checking for us if it could, it is clear we have come to an interesting moment in writing instruction. In ten short years we have gone from the computer serving as a passive instrument for writing (the word processor) to the computer offering to really process words -- to comment on their quality and correctness. This may appear to be quite a recent development. Those who are just discovering efforts along these lines, though, should not be too surprised. Actually the programs of today are the result of twenty years' effort. There is nothing new about using the computer to correct papers. What is new is the improved performance of such programs, and the increased availability of such programs at low cost.

The history of computer text analysis, while brief, is complicated by the fact that there are actually three distinct efforts underway to use the computer for such purposes. There is a certain amount of overlap between the efforts, but their intentions are different enough to warrant separate review.

The first effort is toward automatic analysis of papers. In this approach, the computer is used to fully "correct" or otherwise comment on papers. You put a paper in, the computer works for a few minutes, and out

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comes a list of errors and other comments.

The second effort creates a more cooperative relationship between the computer and writer. The computer performs a series of activities that make proofreading easier for the writer, but the writer is still in charge -- still selecting which activity to perform, which changes to make. The computer is a tool doing the bidding of the writer.

In the third effort, the computer is even less directive. In this effort, the process for revision and analysis is initiated by writers working collaboratively. The computer serves as communication node as peers comment back and forth, reacting and revising over a period of time. The computer facilitates interaction between writers, and introduces no direction of its own.

Now for the history. Each of these efforts has evolved over time. Each is based on the work of people whose names and programs are generally unknown. Nevertheless, the connection of the early work to present developments is easy to discern once you look.

## Automatic Correction Programs

Let's begin with the history of automatic correction. There were several people at work in this area already in the late 1960s. Ellis Page was one. Page tirelessly copied student essays onto punched cards, and then had the computer check them for such characteristics as sentence length, word length, subordination, coordination, and essay length. He was able to group these essays according to traits he found. Some were characterized by a tendency to use longer words, write longer sentences, and write longer essays; others tended in the opposite direction. Ultimately he created a formula which automatically placed essays into one of five groups -- each group corresponding to a letter grade -- A to F.

To evaluate the reliability of his formula, he had several high school English teachers also rate the collection of essays, and he compared their grade to the computer's. The correspondence was sufficiently strong that he felt the computer could in fact "grade" student papers (Page).

A group of his colleagues later tried a different tack. They created

three lists of words roughly characterized as "vague, opinionated, or specific." They decided that a formula could be created comparing the presence of such words. In their estimation essays with more specific words and fewer vague or opinionated words would be superior to those that were highly opinionated or vague. They had the computer count such words and used their formula to grade a collection of student essays. Once again the grades of the computer were compared to that of human readers. They found their program gave the essays roughly the same grade (Hiller).

Neither Page's or Hiller's formula is in use today, but a variety of programs do the same kind of counting. An interesting example is HOMER. Begun in 1980, the program uses the style measures developed by Richard Lanham in Revising Prose. The point of both the book and the program is to find "bureaucratic" writing (Cohen). To Lanham, that is writing characterized by long sentences, passive voice, many prepositional phrases, and nominalized verbs. HOMER searches through student text for instances of bureaucratic writing and responds with such comments as "Oh my, all those TO BE verbs distress me," and "You keep your prepositions under control -- how admirable." In essence, the program is doing the same kind of work Page was doing twnety years ago -- checking sentence length, looking for particular kinds of words, and making comments about text quality.

Computers can easily be programmed to search for particular words. There has long been an interest, however, in looking beyond words to longer sections of text. Could a program, for instance, be written to check the grammaticality of a sentence? To do so, the program would have to be able to understand the syntax of English -- identify the subject, the verb, correctly understand the relationships of various phrases. Clearly not an easy task.

Primitive efforts along these lines date back to early work on machine translation -- the attempt to translate English automatically to some other language (generally Russian). A variety of techniques were developed. Most focused on the parsing of sentences. Augmented Transition Networks and Chart Parsers are just two approaches that gained some support. In each case the program recognized one word at a time, accessed a dictionary to learn about its common parts of speech, and tried to build a connection between that word and other words in a sentence.

It turns out to be a very difficult task. Most words can take many parts of speech. "Book" can be a noun, but also a verb -- "Book 'em Dano," and an adjective -- "book worm." Since a program isn't sure in which sense the word is being used, it may have to keep several tentative representations for the sentence until additional words help clarify which use of "book" is intended. This creates some real programming problems, but nothing compared to the other problem -- what if the sentence isn't grammatical? What happens if words have been left out (as is often the case in conversation), or are misused, or have simply been typed wrong? Now the computer has a problem.

Such problems have yet to be solved. There is no program that can determine the correct syntax of English. We simply can't do it.

Nevertheless, there are programs that try -- programs that take student writing and try to pick out errant pronoun reference, incomplete sentences, faulty coordination.

There are two programs that have gone the farthest. Both programs are the result of substantial research and development efforts, both are the products of major computer corporations, and both were intended initially for use by business writers.

Epistle was the product of IBM. Initially developed to read and analyze business letters, the program has since been redesigned and renamed. It is now Critique and is being tested at Colorado State University and the University of Hawaii (Wallraff). According to one of the users at the University of Hawaii (Brock), the program is roughly 95% accurate. 95% of the time the program can tell if a sentence is malformed, if words have been misused, if punctuation has been misplaced. Student papers are checked for error, and the program automatically suggests corrections.

Writer's Workbench is the product of At&T. It was originally used to help AT&T's technical writers improve their documents. Beginning in 1981 Colorado State University was allowed to test the program with college freshmen. The program does not have the ability to identify problems with sentence structure or incorrect punctuation, but does highlight the use of passive voice, check spelling, determine readability levels, list vague

words, and identify parts of speech, among other things. The program is now being sold to other colleges.

A number of programs have since appeared that follow the general approaches of these two programs. RightWriter, Correctext, and Grammatik are direct descendents. Each program reads a student paper and responds with a list of errors and suggestions. Some programs make more suggestions than others, but in each case the intent is the same -- the computer serves as editor. Students read the suggestions made by the program and rewrite their work. The computer provides the direction -- the student follows along.

Unfortunately, there is still one substantial limitation to such programs -- they aren't right. Every program listed above makes errors. Even Critique is only 95% accurate. That may seem excellent (and it is a major improvement over earlier programs of this type), but remember that 5% of the time the program is telling the student to do something wrong. One time in twenty the program is telling students a sentence is wrong, when it is right. This can be especially confusing for students whose grasp of grammar rules is weak to begin with. 5% of the time they are being taught to do something wrong.

## Computer-assisted Review Programs

In 1981 Bolt Beranek and Newman, a Massachussets-based research corporation, received a US Department of Education contract to develop a writing tool for grade school students. The result was Quill, a program that incorporated prewriting activities, a word processor, revision aids, and collaboration tools. The program was intended for younger students, but its design set the standard that has been used by many programs since then.

One of its strengths was its unique orientation to revising. The program made no attempt to find errors. Instead, the program repositioned text so writers themselves could more easily spot errors. For instance, students could ask the program to reformat their text so that each sentence was presented alone on the screen. The program made no comments at all about the sentence, but students found they could better evaluate the sentence for structure and completeness -- there was no

distraction from the preceding or following sentence.

Such an approach has an underlying premise -- students will find errors on their own and identify necessary changes on their own, if the computer will present their text in a manner that facilitates their review. This of course is not always the case, but it is an approach that does work in many cases and for many students. It is also an approach that changes the relation between computer and writer. Where the automatic programs take responsibility away from the student, the review programs put the responsibility for changes back on the students.

A more current program that follows this approach is Writer's Helper Stage II. While it contains automatic checks for such things as homonym confusions, usage errors, and sexist language, most of its revision tools simply recast text to make review easier for students.

For instance, it too will display each sentence of a text individually on the screen for careful review and editing. But it also helps with longer blocks of text. If a student wishes, the program will print out the first sentence of each paragraph. This list helps a student see if the text moves directly from one point to another, or begins to drift. The program will also display the first and last sentence of each paragraph. This check lets students see if the paragraph stayed on the same subject, or wandered. In each case, the program makes no comment -- its role is to reposition text in helpful ways and leave the actual discovery of problems to the writer.

Writer's Helper Stage II also helps writers review their writing in terms of audience. It computes many of the measures first developed by Walker Gibson in his classic Sweet, Tough and Stuffy, so students can get an initial idea of their style. Again, the program does not direct them toward one "correct" style, but makes them aware of what they are doing so they can decide if their writing matches their intentions and their audience. Along the same lines, the program identifies a diction level, highlights transition use, and points out all references readers are forced to make as they read. Students themselves must then decide if they are addressing their subject with appropriate formality or placing an extra burden on their readers.

Programs such as these distinguish themselves from the automatic proofreaders in two ways. First, they return responsibility to the writer.

They can help writers see additional aspects of the text, but it is up to writers to respond to what the computer is helping them see. Second, these programs generally raise more advanced issues for writers. Where the proofreading programs look for problems with pronoun reference and punctuation accuracy, the review programs help writers consider diction, audience and style -- review programs help writers look beyond where commas are to where readers are.

## Collaborative Revision Programs

The newest effort in computer-aided revision takes the computer even more into the background. Here the effort is to support peer editing and revising with the computer simply acting as the platform upon which this collaboration can take place.

One approach along these lines has been to link schools and even countries together through electronic mail. Students write letters or reports and send them electronically to students halfway around the globe. Within a day or two students in the other country have read the reports and sent responses back. Everything happens much more quickly than it would through regular mail, quickly enough so that students in the second country can actually involve themselves in writing projects in the first country. For instance, a group of Massachusetts sixth graders learning about South America could use a word processor to create a list of questions and electronically "mail" them to sixth graders in Argentina. Students there could answer the questions and supply additional information about their country. Back in Massachusetts, the students write a draft of their reports, and "send" them back to Argentina. The Argentine kids read and correct those drafts, helping the American kids see what they missed. The computer functions as word processor and "mail slot" while the real revision is done collaboratively between the students.

A leader in this effort is Al Rogers. The developer of FrEdWriter, a public domain word processor, Mr. Rogers has spent the last several years developing software to simplify the process of connecting a computer in Los Angeles to one in Topeka or Hong Kong. He has also created the basis of a network which helps establish routine links between schools and countries. The result is a level of collaboration that simply wasn't possible before computers became communication nodes.

A second approach to computer-assisted collaboration is evolving within single classrooms. The point here is to link students constantly while they write at a computer. In one implementation, writing is done in a computer lab. Each student is seated at a computer and writes a series of drafts at that computer. There are only two differences between this new system and the kind of writing environment that is more typical on college campuses. First, all the computers are linked to each other so that they can send pieces of text back and forth, and second, the computer system is set up so that the monitor is divided into areas or "windows" with one window serving as a normal word processing screen, while a second window carries a running dialogue between the author and any number of other writers in the room.

A leader in this effort has been ENFI (Electronic Networks for Interaction), a project led by professors at Gallaudet University, Carnegie Mellon University, The University of Minnesota, New York Institute of Technology, and Northern Virginia Community College. The network developed by this project attempts to link students constantly so that they can collaborate through the entire writing process. It would seem unnecessary to use the computer in this way since the writers are generally in the same room with each other and could easily just talk to each other (and often do), but research done by Trent Batson of Gallaudet helps define the role such computer-based communication can play during writing.

He compared computer-based collaboration to face-to-face collaboration during a series of writing tasks. The differences were substantial. The face-to-face collaboration tended to be less "collaboration" and more listening to one dominant individual. Batson found 33% of all statements were made by one person, while another only spoke 7% of the time. Most of us would recognize similar trends in our classroom discussion. Computer-based interaction, however, was virtually equal among participants.

The second major difference was in quality of interaction. Face-to-face interaction was "jumbled, repetitive, fragmented, intermixed whereas in the computer interaction they were developed, complex, organized -- written as opposed to spoken discourse" (Batson). The computer-based collaboration also created a transcript which students could refer to later if they wished.

As a result of such observations, the computer is more and more frequently being used as a communication device for students who clearly could communicate in more traditional ways. The computer enhances the quantity and quality of peer communication -- it is an effective tool to improve collaboration.

And so there you have it -- three distinct approaches to computer-assisted revision. Each has a different purpose, each has a different role for the computer, and each has a different lineage. All three of the approaches are still changing as the technology changes and as we discover ways to effectively use what the technology enables. It is interesting to see, however, just how indebted we still are to people who developed initial projects in this field when punched cards were the primary connection of people to computers. The programs of today don't require punched cards, but they still do many of the things those old programs did. We haven't evolved our use of computers so much that we can't still look at a few programs and see connections to Ellis Page and almost hear the riffling of punched cards running through a card reader in some distant basement computing center.

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